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(56) Documents cited
GB 1529648 **GB 1409666** **GB 1201349**
GB 1527600 **GB 1366841**

(58) Field of search
G4N

(54) Surveillance system

(57) A surveillance system comprises picture producing means (A) for producing a picture of an area under surveillance, comparison means (5) for comparing the picture produced with reference data and signal producing means (18) for producing an alarm signal when the difference between the picture and reference data exceed a predetermined threshold.

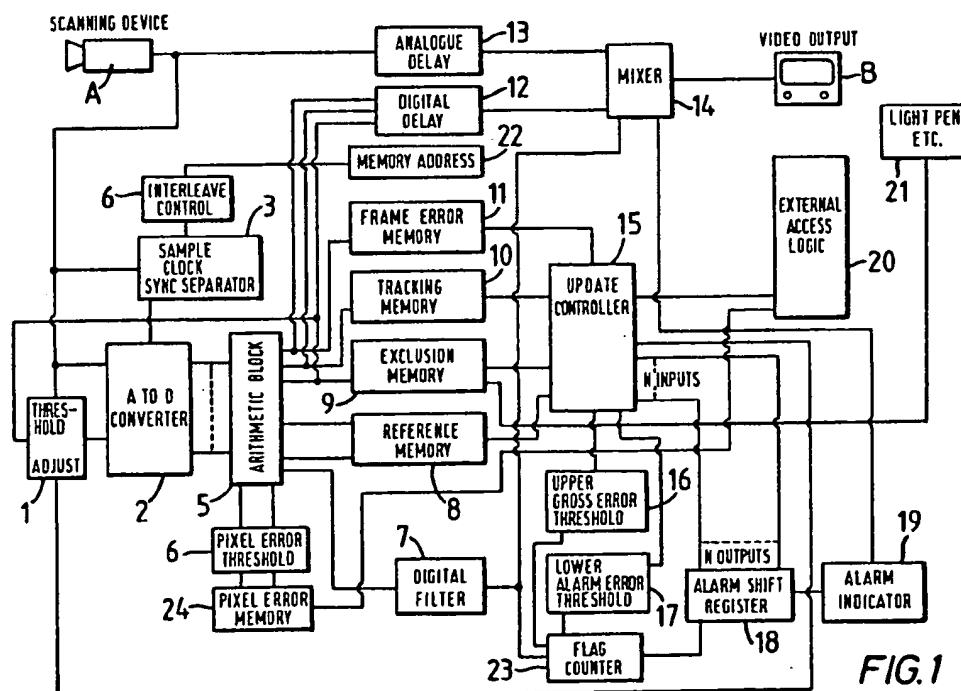
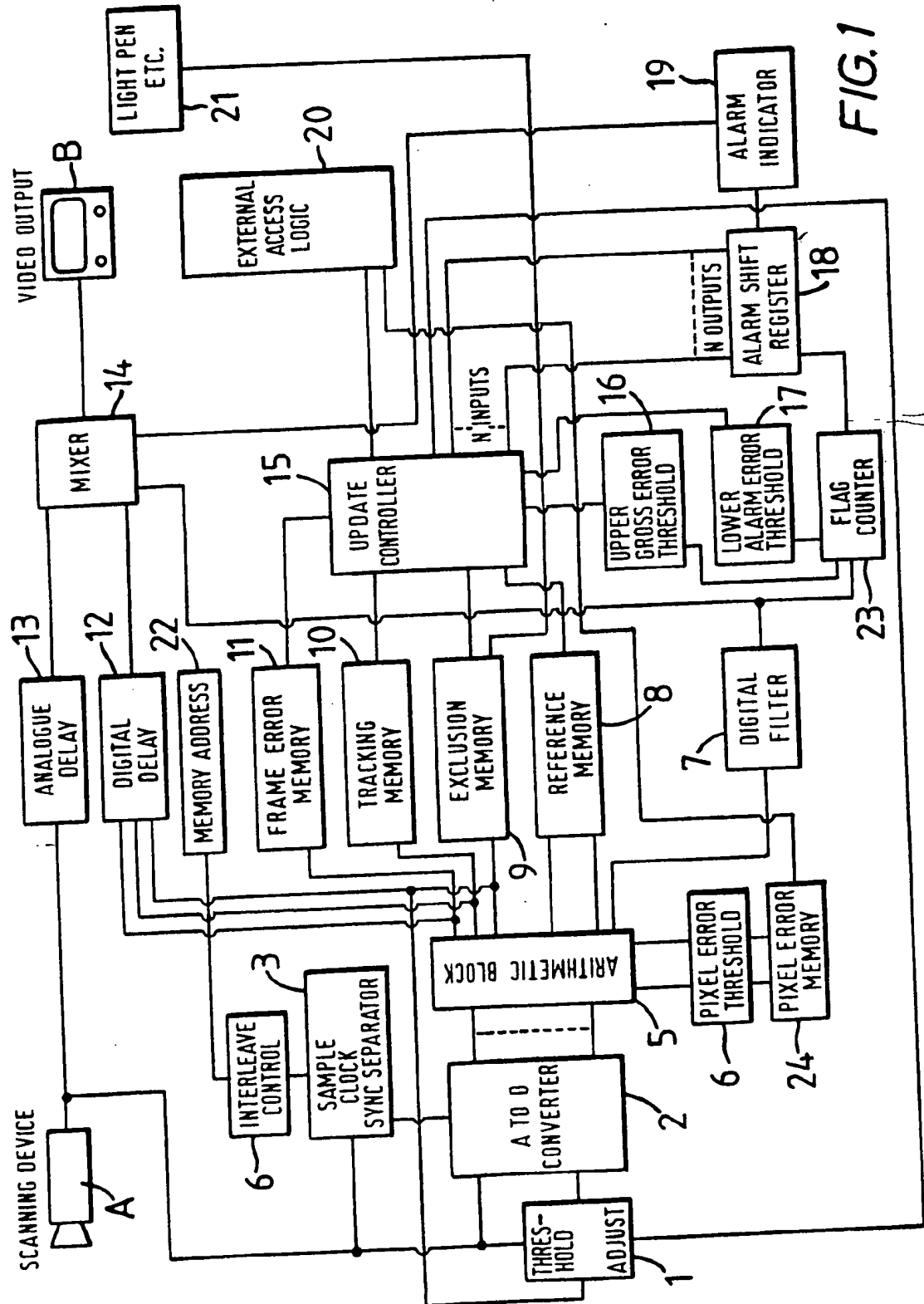


FIG.1

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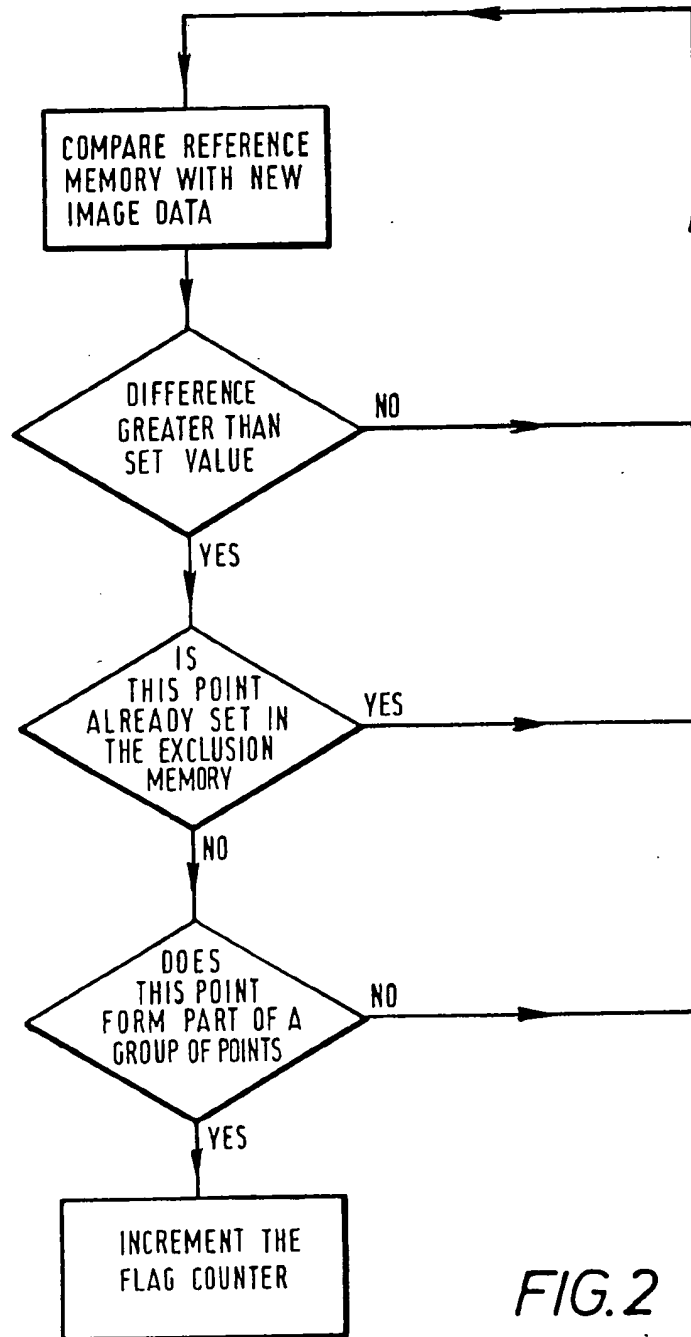


FIG. 2

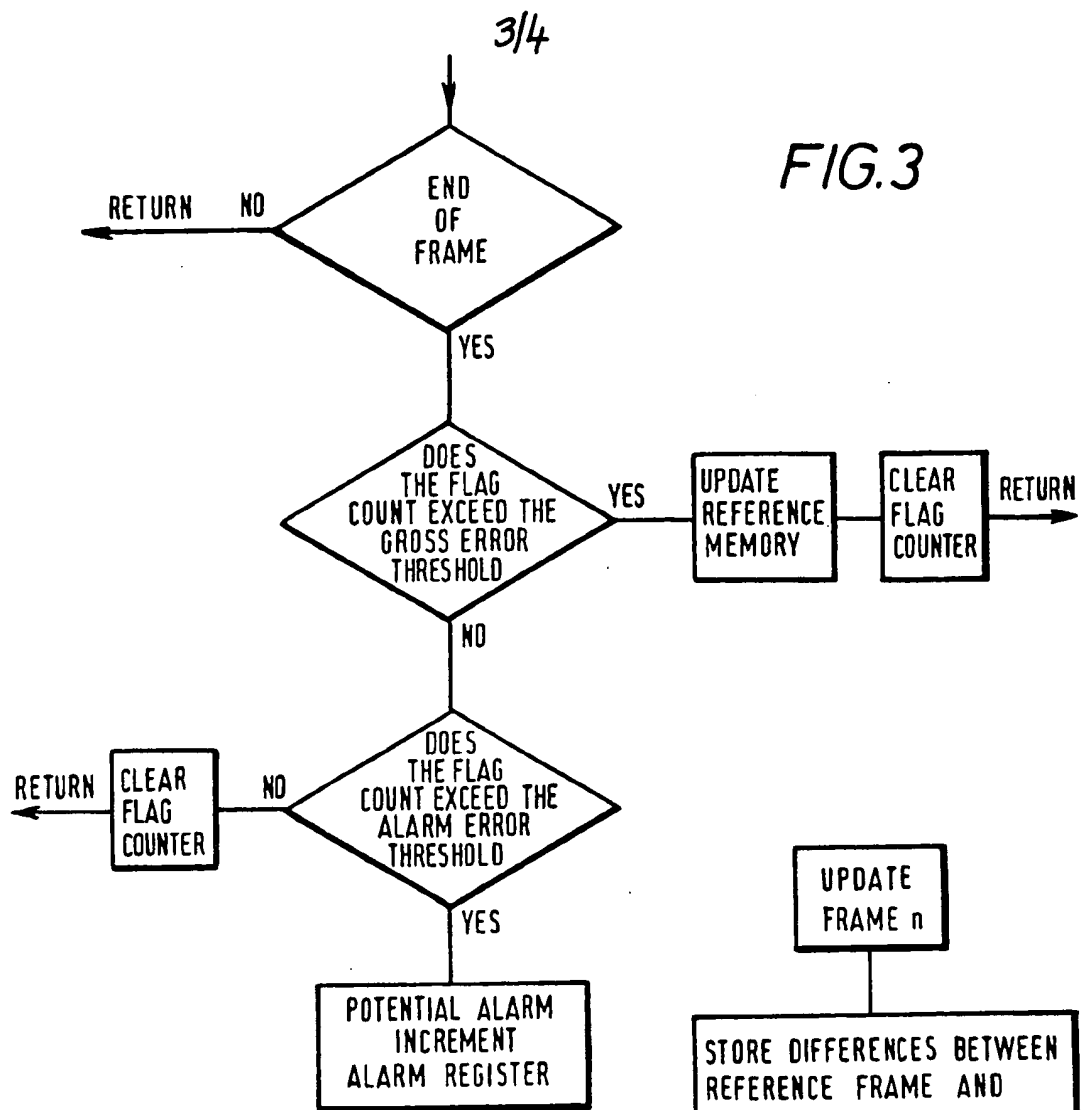


FIG. 6

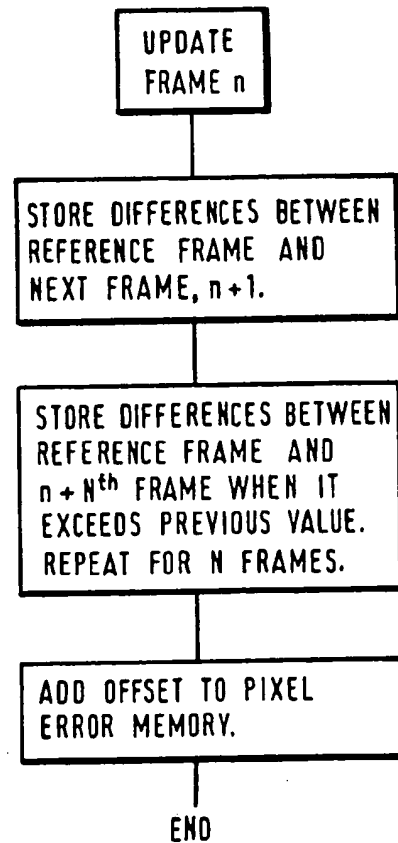


FIG.4

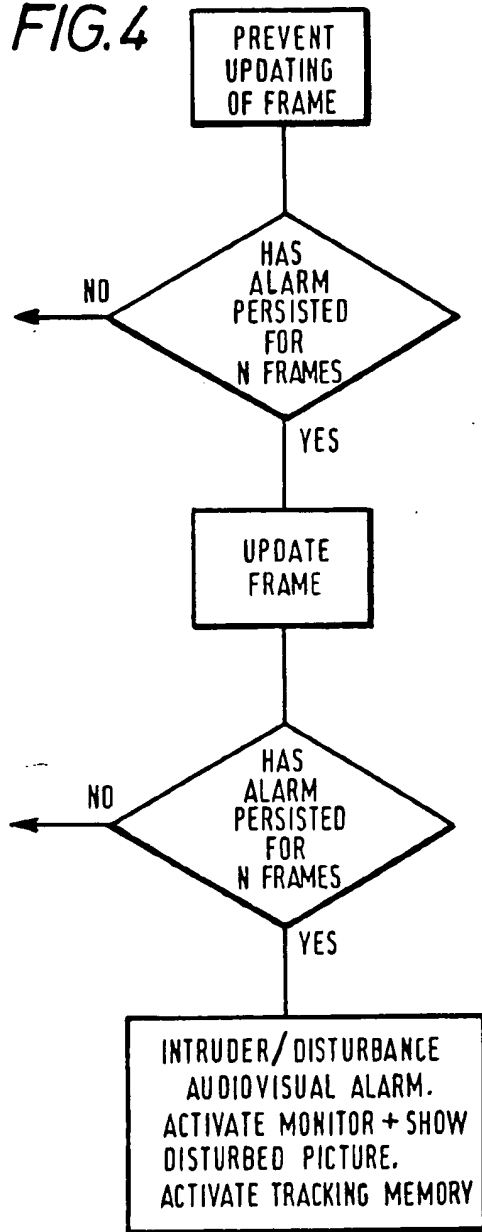
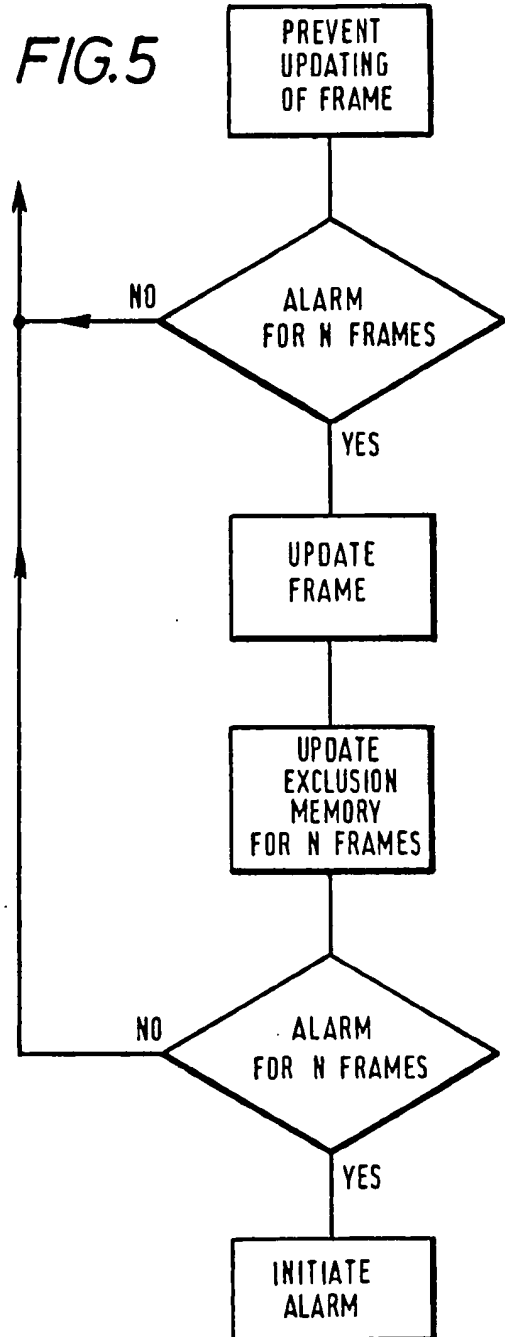


FIG.5



SPECIFICATION

Surveillance system

5 This invention relates to a surveillance system which operates automatically to provide information about an area under surveillance.

Many systems have been proposed for automatic surveillance ranging from the relatively
10 simple in the form of pressure pads, trip switches and the like to the relatively sophisticated which may use television cameras and complex electronic control equipment.

Even the most sophisticated of these known
15 systems suffer from a number of disadvantages. Thus many false alarms can be produced merely from signal noise and the detection of unwanted data.

The present invention seeks to provide a
20 surveillance system of a sophisticated nature in which the presence of faulty alarm signals are reduced without reducing the effectiveness of the system.

According to the invention, there is provided a surveillance system comprising means
25 for producing a picture of an area under surveillance, means for comparing the picture produced with reference data and means for producing an alarm signal when the differences between the picture and reference data
30 exceed a predetermined threshold.

Further according to the invention, a surveillance system comprises a video camera for
35 producing a picture of an area under surveillance, an analogue to digital converter for converting the signals of the video camera into a digital signal, a reference memory for storing a reference picture in digital form, comparison means for comparing incoming
40 picture in pixels with the data from the reference memory, threshold means for determining when the differences between the actual and reference pictures exceed a predetermined threshold, and means, responsive to
45 the threshold means for producing an alarm signal.

Preferably updating means are provided for updating the reference memory at predetermined intervals. Means may be provided for
50 determining the existence of sudden or transient changes in the picture and suppressing alarm signals when these occur.

Means may be provided for delaying the alarm signal until the alarm condition has
55 been present for a predetermined length of time. Means may also be provided for varying the sensitivities of the system across the picture area in dependence on changes in the picture.

60 In order to avoid surveillance in unwanted areas, areas of the picture may be chosen for exclusion and stored in an exclusion memory. An indication of the track of the intruder may be provided by storing the track of the intruder
65 in a tracking memory.

The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:—

70 *Figure 1* is a block diagram of a surveillance system in accordance with the invention;

Figure 2 shows the logic path used to set a flag;

75 *Figure 3* shows the logic path used to recognise a potential alarm condition;

Figure 4 shows the logic path used to recognise a moving object without using the exclusion memory;

80 *Figure 5* shows the logic path used to recognise a moving object using the exclusion memory, and

Figure 6 shows the logic path used for adjustment of the pixel error threshold.

Referring first to Fig. 1, the surveillance
85 systems provides a scanning device A, such as a video camera, which is set up to scan the area under surveillance. The output from the scanning device is split into two branches, one of which passes by way of an analogue
90 delay circuit and a mixer to a video output B, e.g. a television monitor and the other of which passes into the electronic control system.

In the electronic control system, the signal
95 is fed to a synchronisation separator 3 which determines the start/end of each frame of the video signal. The signal passes from the sync separator 3 to an interleave control 6 which is set to the number of frames in a complete
100 picture and then to an address counter 22 which counts on for each pixel received from the scanning device A. This address counter 22 is used for addressing other memories in correspondence with the received scan.

105 The scanned signal is also passed to an analogue to digital converter 2 which is controlled by a threshold adjustment circuit 1 and by a sample clock included in the unit 3. The converted signal is then fed in parallel to the arithmetic unit 5 to which are fed data
110 from a reference memory 8, holding a reference picture, and a pixel error threshold which is produced from a pixel error memory 24 and a pixel error threshold circuit 6. There is two
115 way communication between the arithmetic unit and an exclusion memory 9, a tracking memory 10, a frame error memory 11. An output from the arithmetic unit passes to the threshold adjusting circuit 1. A further output
120 passes, by way of a digital delay circuit 12 to the mixer 14. A last output passes by way of a digital filter 7 both to the mixer 14 and a flag counter 23.

The flag counter 23 feeds an alarm shift
125 register 18, a lower alarm error threshold circuit 17 and an upper gross error threshold circuit 16. Both of these latter feed an update controller 15 controlling updates of the various memories. Also fed to the update controller
130 are the contents of the alarm shift register

18 (in parallel). The alarm shift register 18 also provides a signal to the alarm indicator which in turn feeds the mixer 14.

Additionally provided are an external access logic 20 used to control the manually set parameters of the system and a light pen circuit 22 used for indicating excluded areas.

The operation of the system will now be described.

10 The scanning device A is set up to scan the area under surveillance and transmits a picture via the analogue delay circuit 13 and the mixer 14 to the video display B. The operator can then examine the picture produced and indicate, e.g. by means of the light pen circuit 15 21, areas of the picture which are not relevant to surveillance operation. This information is then passed for storage to the exclusion memory 9 via the update controller 15. The signal 20 from the scanning device A passes to the electronics control system. The input thresholds for the signal are set by means of the threshold adjusting circuit 1 and these thresholds vary over the picture areas of interest in 25 order to maximise the useful range of the system.

The scanning signal is then converted from analogue to digital in the converter 2 and passed through the arithmetic unit 5 to the 30 reference memory 8 to provide an initial reference image. Further signals from the scanning device will be compared with the data from the reference memory in order to determine whether there has been any change in the 35 picture.

The sync separator 3 is used to reset the address counter 22 at the end of each complete picture. Where 2:1 interleaving is used, the resetting of the address counter will take 40 place after two frames under the control of the interleave control circuit 4. By this means, the various memories can be correctly addressed so that the part addressed corresponds to the pixel being scanned in the 45 scanning device A. The sample clock of the sync separator 3 is synchronised to the start of each scan. It is to be noted that with memories of sufficient size, a wide range of frame scans can be utilised e.g. from 500 to 50 1000 lines.

As the second and following pictures are received, the digital signal, as an n bit binary code, is compared on a one for one basis with a corresponding code stored in the reference 55 memory 8 (suitably as a result of the first picture). The difference between these codes is calculated in the arithmetic unit 5 and the result is compared to a number supplied by the pixel error threshold circuit 6. This threshold 60 may vary across the picture as necessary. If the threshold is exceeded, a flag is set.

If the flag corresponds to a point in an excluded area as stored in the exclusion memory 9, then it is ignored. If it is not in such an 65 area, the flag is stored in the frame error

memory at an address corresponding to the pixel being dealt with. Furthermore, if, as will be explained hereafter, an alarm state has been indicated, the flag is also stored in the 70 tracking memory.

Because, in normal circumstances, a number of flags will be set on each complete scan, only those flags which are members of groups of flags (not necessarily contiguous) are allowed to pass on by the digital filter 7. This 75 filter acts to filter out noise from the signal and also eliminates non significant movements.

Those flags which pass through the filter 7 80 are counted by the flag counter 23. The total count at the end of each frame is compared with the value of a lower alarm error threshold 17 and the upper gross error threshold 16. If only the lower alarm error threshold 17 is 85 exceeded, then a potential alarm condition is recognised and the alarm shift register 18 is incremented. On the other hand, if the gross error threshold 16 is exceeded as well, this indicates that the count is the result of a non 90 alarm condition e.g. a fault in the system, noise, transient or sudden changes such as light-strength variations. In this circumstance, the potential alarm condition is ignored and the reference memory 8 is updated by the 95 update controller 15.

Even when a potential alarm condition is recognised, this does not immediately set off an alarm but merely increments the alarm shift register 18. After a predetermined number 100 of potential alarm conditions, the alarm shift register becomes full and passes a signal to the alarm indicator and sets off an alarm.

At the same time, the position of the intruder is highlighted on the television monitor B.

105 The various delays in the circuitry are so arranged that the highlighted area exactly matches the position of the intruder. The digital delay circuit 12 allows data from memory addresses to act upon the exact position 110 of the analogue waveform to which the data refers. This is particularly useful when various additional data is to be shown on the screen. Thus, the additional data can be taken from the tracking memory 10 (display of the track 115 of the intruder), the exclusion memory 9 (the desensitised areas) and the frame error memory (intruder position prior to filtering).

The update controller 15 will update the reference memory at suitable time intervals 120 which may be set as desired by the operator. An update as a result of a gross error will restart the update time interval. Update is also controlled by shift-register 18.

Figs. 2 to 6 show logic paths involved in 125 various operations of the system.

In Fig. 2 is shown the logic path for setting flags. Thus the operation carries out the various comparisons indicated to determine whether the flag should be set.

130 In Fig. 3, recognition of a potential alarm is

shown. At the end of each frame, a check is carried out, first against the gross error threshold 16 then the alarm error threshold 17. If the first is exceeded the reference memory 8 is updated and if the second is exceeded the alarm shift register 18 is incremented. Appropriate clearing of the flag counter is shown.

Figs. 4 and 5 show two logic paths for recognising a moving object. Fig. 4 does not use the exclusion memory 9 while Fig. 5 does.

The present circuit provides for automatic adjustment of the pixel error threshold for maximisation of the incoming information. The logic path for this is shown in Fig. 6. In order to carry out this operation, the differences between the reference frame and the next frame are stored and the store is updated whenever a larger difference is detected. After a predetermined number of frames, an offset is added to the pixel error memory. In this way a varying threshold is provided across the screen in dependence on changes in the scanned pictures.

Similar variations can be achieved in respect of the input threshold adjustment by the input threshold adjust circuit 1.

It will be appreciated that various modifications may be made to the above described embodiment without departing from the scope of the invention. For example, for simplified systems, certain of the features could be omitted. Thus the tracking feature could be left out, thus producing a saving on the tracking memory. Likewise, the exclusion feature could be omitted.

A system with remote scanning devices could be used each feeding a central processing circuit. In this event, multiplication of the processing circuits could be used. Alternatively only multiplication of memory would be needed if the processing arrangements operated on a time multiplexing system.

Video recording could be used whereby a video recorder is activated by an alarm.

CLAIMS

1. A surveillance system comprising picture producing means for producing a picture of an area under surveillance, comparison means for comparing the picture produced with reference data and signal producing means for producing an alarm signal when the differences between the picture and reference data exceed a predetermined threshold.

2. A surveillance system comprising a video camera for producing a picture of an area under surveillance, an analogue to digital converter for converting the signals of the video camera into a digital signal, a reference memory for storing a reference picture in digital form, comparison means for comparing an incoming picture in pixels with data from the reference memory, threshold means for determining when the differences between the ac-

tual and reference pictures exceed a predetermined threshold, and signal producing means, responsive to the threshold means for producing an alarm signal.

3. A system as claimed in claim 2, wherein updating means are provided for updating the reference memory at predetermined intervals.

4. A system as claimed in claim 2 or 3, wherein means are provided for determining the existence of sudden and/or transient changes in the picture and suppressing the alarm signal when these occur.

5. A system as claimed in any one of claims 2 to 4, wherein delay means are provided for delaying the alarm signal until the alarm condition has been present for a predetermined time.

6. A system as claimed in any one of claims 2 to 5, wherein means are provided for varying the sensitivities of the system across the picture area in dependence on changes in the picture.

7. A system as claimed in any one of claims 2 to 6, wherein an exclusion memory is provided for storing areas of the picture which are to be excluded from the surveillance.

8. A system as claimed in any one of claims 2 to 7, wherein a tracking memory is provided for storing the track of an intruder detected by the system.

9. A surveillance system substantially as described herein with reference to the drawings.

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